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A Design of IOT Gateway for Agricultural Greenhouse

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Abstract

Agriculture in India faces several constraints, including extreme temperatures, water scarcity, sea water desalination costs, and non-fertile soil, acute water shortage for agriculture. Various wavelength of light plays specific roles for plant growth since different photosynthetic pigments within plants. Prolonged dry environment or high temperature can make the delicate sepals dry quickly and results in the death of flower before maturity.

Hence, there is an immediate need to improve the system, which can increase the yield and produce healthy organic food. We place temperature and humidity sensor inside the smart greenhouse to measure humidity and temperature. When the temperature rises above a certain level, microcontroller will trigger relay attached to the fogger, which will sprinkle tiny water droplets of size of micron which will remain suspended in the air and bring the temperature down.

Keywords *– Blynk Application, Intelligent Greenhouse Agriculture, Temperature ControlSystem, Internet of Thing(IOT).*

I. INTRODUCTION

Greenhouse allows producing crops, especially fruits and vegetables production that requires cold weather to grow fast in a quality manner. It is impossible to enhance the production of vegetables and fruits like tomatoes, Cucumbers, Sweet peppers and strawberries, as the optimum temperature for their growth falls in the range between 11°C to 28°C. The use of IOT in greenhouse agriculture contributes to its development In this paper, based on the IoT new advances in using sensors equipment, we propose to build an intelligent Energy-Efficient (EE) system which monitors and controls internal greenhouse temperature. The proposed system will allow increased and improved productivity. The main study objective is not only to build a consistent growing environment, but also to automate the whole system and make it smart to save energy and production costs. The proposed approach focuses on monitoring and controlling greenhouse internal temperature, but it can be extended to other kinds of properties, e.g. Carbon dioxide (CO_2) and humidity. The proposed system is considered as smart because it is able, autonomously, to monitor the outside temperature and the energy consumption rush hours, in order to accurately generate the suitable reference temperature, and ensure that the greenhouse temperature reaches this reference temperature. In addition, this system can identify the angle of the Sun rays in order to control the opening and closing of the awnings, which results in reducing the effects ofhigh temperatures.

II. RELATED TECHNOLOGIES

a) IOT SENSORS

A broad variety of sensors that provides a mature sensing technology for greenhouse monitoring applications is available in markets. These sensors can be utilized for collecting, automatically, important information including microclimate data in the greenhouse, control actions, crops growth rate and characteristics of the crops and more related data. The availability of these various kinds of advanced sensing technologies in the markets makes the implementation of the proposed IOT-based system is achievable. Temperature sensors, for instance, can be used to measure, periodically the temperature inside the greenhouse. There are some common models utilized for this purpose, such as LP PYRA 02 [4], E+E Elektronik EE160 [18], DHT11 [19, 20], and LM35 model [21]. On the other hand, Humidity sensors can beutilized for sensing the amount of vapors in the air, such as LP PYRA 02 [4], E+E Elektronik EE160 [18], DHT11 [19, 20], and HSM20G [21]. Additionally, there is another important sensing technology need to be utilized inside the greenhouse for measuring the level

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of CO2. It is available in markets with different models such as Vaisala GMP220 [4]. Sensors for sensing the density of Sun rays is also another kind of critical and sensitive technology required in the greenhouse visible, such as LP PYRA 02 [4], and Apogee Instruments Inc. SP110 [18].

b) PRINCIPLE OF MODEL TRANSFORMATIONS

Automatic model transformation (MT) is considered a key principle in advanced model-oriented software development methodologies, such as Model-driven Engineering (MDA). Models, as abstracted views of the system, are considered primary artifacts used throughout the development lifecycle instead of code. These models express the system from different views and at multiple levels of abstraction to enable the separation of concerns based on developer’s perspectives. The MDA- based approaches are based on utilizing three kinds of core models, namely,

Computation Independent Model (CIM), Platform-Independent Model (PIM), and Platform Specific Model (PSM) [33].

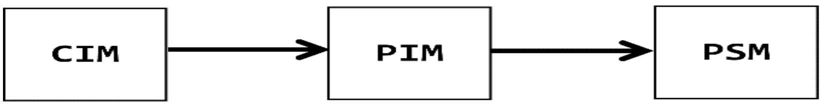

FIGURE 1. **Steps of transformations**

III. SYSTEM DESIGN AND ARCHITECTURE

Basically, it is assumed that the proposed greenhouse system for controlling and monitoring temperature consists of three main subsystems, namely, temperature control & monitoring subsystem, greenhouse management information system, and data conversion subsystem, rather than starting the design description using collaborated classes and responsibilities. This strategy simplifies the complexity of intercommunications and collaborations between the system units. The following UML component diagram (Figure 2) is used to demonstrate the overall architectural design of the proposed system via a number of abstracted units (subsystems).

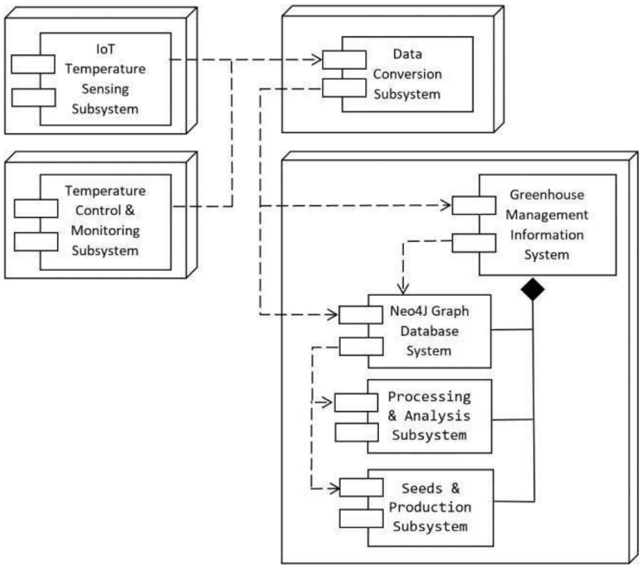

Fig 2. Architectural design of greenhouse

IV.TEMPERATURE CONTROL AND MONITORING SUBSYSTEM.

The first stage is designed to monitor the external temperature and energy consumption rush hours. A wireless sensor network continually measures temperature. As soon as there are changes in the outside temperature this stage should inform the next stage to take the appropriate tasks. Temperature measurements are stored in the backend graph database. The stored data can be very useful in analyzing system properties and in predicting future values of properties via the data processing and analysis subsystem, which is another core component of the greenhouse system. In addition to monitoring outside temperature, the proposed PN will also monitor energy consumption in the national power grid to take appropriate action to reduce energy consumption. Indeed, the PN model will send a moderate temperature a little bit higher that the ideal one during the energy consumption rush hours to reduce the greenhouse consumption and then to participate in reducing energy consumption pressure on the kingdom power grid.

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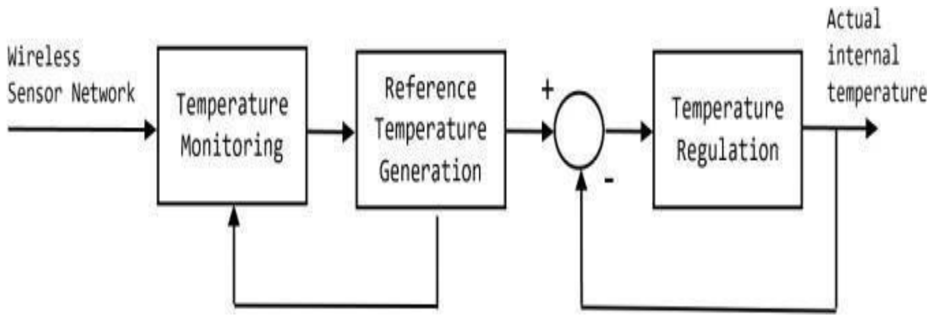

Fig 3. Control System Scheme

TEMPERATURE CONTROL PN PLACES AND TRANSITIONS

Places		Transitions	
P1	17 C <= Temp <= 30 C	t1	17C < Temp < 30C change detection
P2	Temp < 17 or Temp > 30	t2	Temp < 17 or Temp > 30 change detection
P3	Standby mode	t3	Working status changes from Standby to ON
P4	On mode	t4	Working status changes from ON to Standby
P5	Sending ref temp = 27 C. to stage3 during t = 3 min.	t5	Energy consumption rush hours detection
P6	Sending ref temp = 24 C. to stage3 during t = 3 min.	t6	Not energy consumption rush hours detection
P7	Intermediary state	t7, t8, t9, t10	= 1

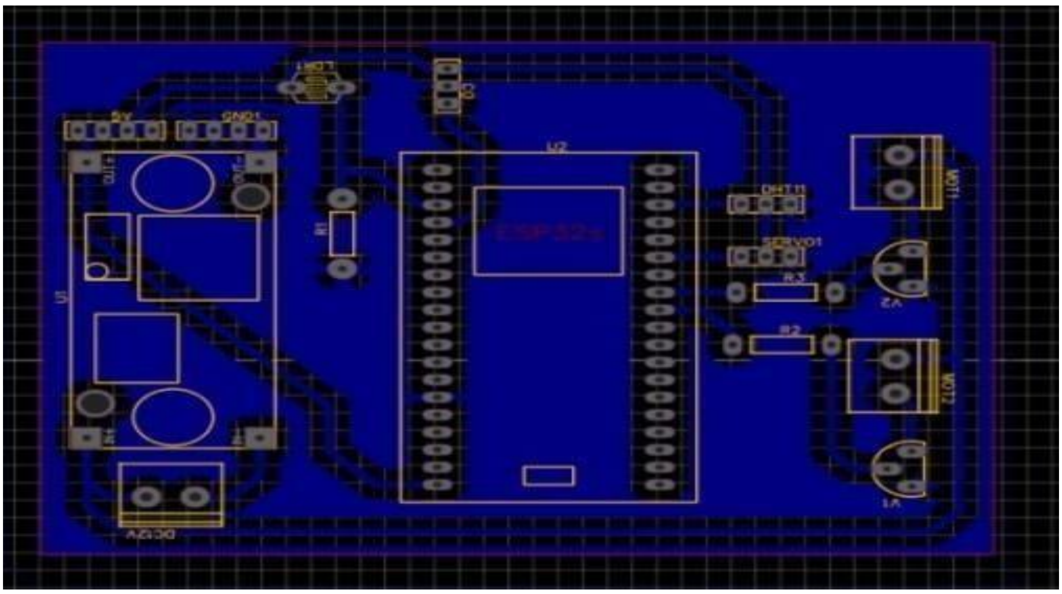

Fig 4. PCB design of the system

IV.CONCLUSION

The proposed system is autonomously able to: monitor the outside temperature, monitor the energy consumption rush hours, monitor the angles of the Sun rays, generate the suitable temperature, send this temperature as a reference signal for temperature regulation, guarantee that the ambient greenhouse temperature reaches this reference temperature, and finally, goesinto standby state in the absence of tasks to accomplish.

This is considered very beneficial while achieving energy savings and reducing production costs, it keeps an appropriate environment for plants to grow. The effectiveness of the proposed approach is demonstrated via a number of simulations that are performed using a greenhouse temperature transfer function.

Additionally, all captured information that is related to energy consumption, internal greenhouse temperature and other agricultural attributes are structured using a proper strategy

of model transformations, then stored and archived in the dynamic Neo4j graph-based database system. This is introduced and discussed as a scalable design of a supporting management information system in the second part of this work.

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